• Gate Overview
  – Types
  – Purposes
  – Locations
• Multi-state review of road closure gates
• Gate usage in Nebraska
  – Automated gate history
  – Road closure procedures & monitoring
  – Upcoming gate deployment project
  – Systems Engineering process
Manual Gates

- Vertical drop down gate
- Horizontal swing style (cattle gate)
- Requires personnel on-site
Automated Gates

- Vertical drop gates are typically light-weight version of railroad gates
- Gates can be operated remotely, but typically staff are on-site
Gate Purpose/Location/Practices

- Gates primarily used for winter weather closure
- Also used for incident management or traffic management
- Primarily used on Interstates and limited access roads
- Supplemental information via “Road Closed” signage, flashing beacons or advance signing
- Most agencies require on-site personnel to deploy gates
- Multiple gates may be needed
- Gates offer full or partial closure
State Interviews

- State DOTs were interviewed to get a better understanding of gate usage
- Nine states interviewed total
  - Nebraska
  - Colorado
  - Iowa
  - Kansas
  - Minnesota
  - Wyoming
  - North Dakota
  - South Dakota
  - Wisconsin
## Gate Totals by State

<table>
<thead>
<tr>
<th>State</th>
<th># Automated Gates</th>
<th># Manual Gates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nebraska</td>
<td>8</td>
<td>50+</td>
</tr>
<tr>
<td>Kansas</td>
<td>0</td>
<td>6 Mainline, 10+ Ramp</td>
</tr>
<tr>
<td>Colorado</td>
<td>0</td>
<td>100+</td>
</tr>
<tr>
<td>Wyoming</td>
<td>4</td>
<td>300+</td>
</tr>
<tr>
<td>South Dakota</td>
<td>0</td>
<td>80</td>
</tr>
<tr>
<td>North Dakota</td>
<td>0</td>
<td>41 Mainline, 24 Ramp</td>
</tr>
<tr>
<td>Minnesota</td>
<td>28</td>
<td>80+</td>
</tr>
<tr>
<td>Iowa</td>
<td>8</td>
<td>100+</td>
</tr>
<tr>
<td>Wisconsin</td>
<td>0</td>
<td>410</td>
</tr>
</tbody>
</table>
State Interviews

- **Wyoming**
  - Gates are used for winter weather 90 percent of the time
  - Gates have recently been used for traffic management
  - Highway Patrol is allowed to close gates without the use of advanced warning or flashers, if gates are manned by a trooper throughout the closure period
  - WYDOT conducted crash testing

- **Wisconsin**
  - Primarily winter weather use
  - Approximately 410 gates statewide that are manually operated vertical drop gates
  - Literature research on freeway ramps was conducted in 1998 and 2011
State Interviews

• Kansas
  – Gates located on I-70
  – Primarily winter weather use
  – Can close if hotel accommodations are lacking during winter storms
  – KDOT utilized Wyoming crash testing research to deploy gates

• Colorado
  – All gates used for inclement winter weather
  – Gates primarily located in the eastern Colorado plains
• **Minnesota**
  – Manual gates used for winter weather closures
  – Two automated gates in southwestern Minnesota on I-90 on-ramp are used for winter weather closures
  – Remaining automated gates are located in metro area for the reversible HOT lane along I-394

• **Iowa**
  – Automated gates on Interstate 35 are used for winter weather closures (‘08/‘09 storm closed I-80 for 3 days)
  – Gates used for incident management in Quad Cities
State Interviews

• North Dakota
  – Winter weather only
    • NDDOT utilized Wyoming crash testing research to deploy gates

• South Dakota
  – Winter weather only
Key Findings

• Most gates are either swing gates or crash-worthy vertical gates

• Most automated gates in interviewed states were issued by same vendor as Nebraska
  – Similar problems with automated capabilities arose in other states
  – Most states not pleased with gate performance

• Many states are looking for improved automated gate status

• Most State DOTs interviewed maintain the gates with internal forces
  – Iowa DOT contracts maintenance out to a contractor
NDOR: Automated Gate History

- Four sets of automated gates were installed between 2006 and 2008
  - Two sets located in Omaha; used for traffic management
  - Two sets located in Western Nebraska are used for inclement weather and traffic incidents
Automated gates have several methods of closing
- Central office control using ATMS Software
- Short-distance DTMF radio control from NDOR vehicle
- Push button on side of gate to lower
- Manually using a drill and winch

ATMS Control System
Automated gates performed well initially
Automated technologies began to fail after one year
  - Gate actuator water damage
  - ATMS communication breakdown
  - Coordination issues between NDOR, gate vendor
Gates no longer operate as originally intended
  - Omaha gates no longer used
  - Western Nebraska gates now used like manual gates
NDOR: Closure Procedures

- NDOR Districts prepare road closures before weather rolls in
- ITS and other physical components deployed before gates close
  1. Dynamic Message Signs (DMS) turn on within I-80
  2. Flashing Warning Signs and arrow boards turn on, advising upcoming closure to drivers
  3. State Patrol use barrels to close specific ramps
  4. Gates closed
NDOR: Road Closure Monitoring

- NDOR staff moves from gate to gate
- Automated Gates can be watched using Closed Caption Television (CCTV) observing the site
PROJECT: 2014-2016 Gate Deployment

- Install automated gates along ramp entrances on I-80 corridor
- Update automated technologies to improve on previous installation
• NDOR and SRF Consulting Group are performing Systems Engineering process
  – Project Plan
  – Systems Engineering Management Plan (SEMP)
  – Concept of Operations
  – Specifications and Verifications
PROJECT: Deployment Plans

- New automated gate mechanism being developed by NDOR; hired 2 UNL students over the summer to assist
- 12 gates will be deployed in 2014
- Four gates planned to be deployed in 2016
  - All gates deployed will be automated and synced with ATMS Software
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